

6.—ZOOLOGICAL NOTES ON A TRAWLING CRUISE IN THE GREAT AUSTRALIAN BIGHT.

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I. INTRODUCTORY.

Fishing in Western Australian waters by steam trawler was first begun as a commercial enterprise towards the end of 1929, the grounds exploited being those at the western end of the Great Australian Bight discovered in 1912 by the Federal Investigation Ship *Endeavour*. This venture, conducted by the Western Australian Trawling Co., Ltd. in the s.s. *Bonthorpe* working from the port of Albany was, however, short-lived (for reasons unconnected with either the supply or marketing of the fish) and the operations lasted only from November, 1929, to March, 1930.

The opportunity offered of forming an acquaintance with the zoology of this otherwise inaccessible region induced the writer to accompany the vessel on one of her cruises, and through the courtesy of the board of directors of the company and of the master, Captain L. W. Claxton, fifteen days were spent at sea, from February 19 to March 5, 1930.

As events turned out only one haul of the trawl was made owing to the failure of the ship's engines while at the fishing grounds, but it was so rich a haul in quantity and quality, that a considerable collection of interesting specimens was preserved from it. From the commercial fisheries point of view it was the biggest single haul made by the *Bonthorpe* during her operations and it was believed to be the largest haul ever secured by trawling in the Bight.

The haul was made at a depth of 93 fathoms at the edge of the Continental shelf, in Lat. $33^{\circ} 15' 0''$ S., Long. $126^{\circ} 22' 15''$ E., a point approximately 75 miles south of Eyre and 150 miles E.N.E. by E. from Israelite Bay. The trawl was put down on February 23, in the late afternoon and the area covered by it was a stretch 100 feet wide and calculated to be $3\frac{1}{2}$ miles long, the period of towing being 1 hour 55 minutes.

II. PHYSICAL OBSERVATIONS.

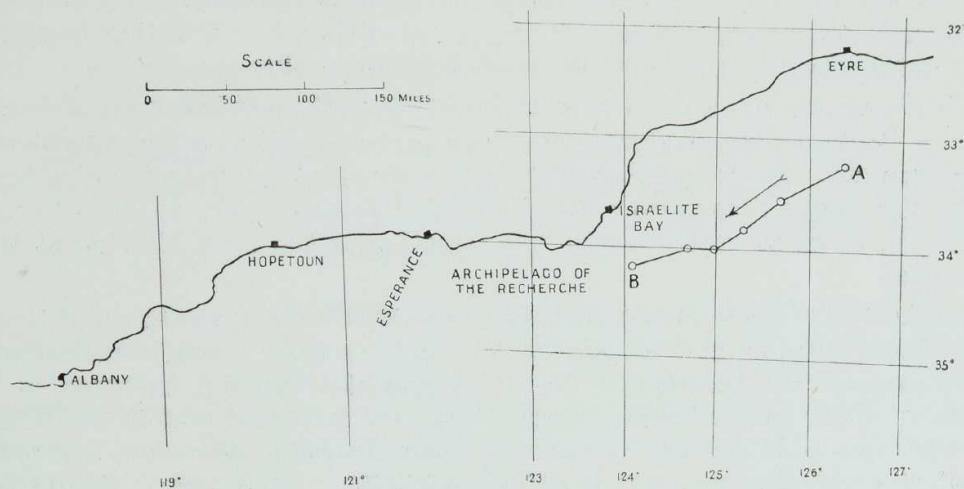
I. TEMPERATURES AND OCEAN CURRENTS.

The temperature of the surface water was comparatively uniform over the whole region, as the accompanying table shows, the range being only 1° C. (= 1.8° F.). The point is of interest in regard to the distribution of ocean currents. Halligan has shown (1921, pp. 189-190) that a warm easterly current sweeps around Cape Leeuwin, and flows some distance from the coast, its waters being 5° F. warmer than those of the cold easterly drift on which it is superimposed and which upwells around the immediate coastline. The uniformity of the temperatures of the present cruise suggests the influence of only one current, the cold one, and that the warm stream does not extend its influence so far north into the Bight as the course taken by the *Bonthorpe*.

Station.	Date.	Time.	Temperature.		Barometer.	Wind.
			Air.	Sea.		
Albany, Town Jetty Lat. $33^{\circ} 45'$ S. ... Long. $124^{\circ} 40'$ E. ...	Feb. 19	p.m. 5.0	21.0°	19.7°	30.12	S.
	Feb. 22	...	18.9°	20.0°	30.22	
Lat. $33^{\circ} 14'$ S. ... Long. $126^{\circ} 16'$ E. ...	Feb. 23	a.m. 10.30	19.2°	19.9°	30.26	E.
	Feb. 24	p.m. 2.0	19.7°	19.9°	30.23	E.
Lat. $34^{\circ} 0'$... Long. $124^{\circ} 56'$...	Feb. 26	3.30	22.0°	20.4°	30.01	{ E. Fairly strong.
	Feb. 27	3.45	20.9°	20.6°	29.99	
13 mi. S.W. of previous position ... Lat. $34^{\circ} 11'$... Long. $124^{\circ} 5'$...	Feb. 28	4.45	22.0°	20.7°	29.74	E.N.E. Slight.
	Mar. 1	2.15	22.5°	20.6°	...	E.N.E. Strong.

A second point concerning the currents of the Bight was revealed through the predicament in which the *Bonthorpe* was placed owing to the failure of the engines at the fishing grounds when the vessel was forced to drift at the mercy of the currents for almost seven days. Daily observations for latitude and longitude throughout this period by Captain Claxton showed that there was a continual drift to the south-west at a rate varying from 12 to 25 miles per day. The *Bonthorpe* commenced her drift on the early morning of February 24 when she was approximately in Lat. $33^{\circ} 15'$ S. and Long. $126^{\circ} 22'$ E. In the late afternoon of February 27 two islands of the eastern group of the Archipelago of the Recherche were sighted. On the morning of March 2, on which day the engines were in commission again, the ship

was west of, and in close proximity to, Salisbury Island. The full period of drift was 6 days 19 hours. The position of the ship during the drift at 4.30 p.m. each day is shown on the accompanying map.



TEXT FIG. I.

Locality map showing the drift of the *Bonthorpe* (from A to B). The point A marks the position of the fishing ground referred to in this paper.

The direction of drift—to the south-west—is contrary to what would be expected in a region where the easterly drift current dominates the water movements. However, in the following excerpt from “The Australia Pilot,” volume 1, page 9, is explained how prevailing winds may materially alter the near-shore circulation of water.

“Near Cape Leeuwin, and off the south coast of Australia the current at all times of the year appears to be principally influenced by the prevailing winds, some vessels having experienced constant northerly and north-easterly currents, running from 1 to $1\frac{1}{2}$ knots, while others have been set to the eastward, and but little to the northward, as they approached the south-western coast of Australia.

“From Cape Leeuwin to the Recherche Archipelago the current usually sets eastward, in a direction parallel with the coast, being strongest between D’Entrecasteaux Point and the King George Sound, where its rate is sometimes $1\frac{1}{2}$ knots. From the Archipelago, round the Australian Bight to Cape Northumberland, it has less strength than farther to the southward; as Bass Strait is approached it is experienced, running eastward and south-eastward at a rate of 1 to $2\frac{1}{2}$ knots.

“From November to April the easterly current abates in strength, and after a fresh easterly wind it not infrequently changes its direction to the north-westward.

“In the offing between Cape Leeuwin and Cape Otway the currents appear to be mainly influenced by the strong westerly winds, which prevail during nine months of the year.

“Near the Australian coast with easterly winds a current has been found setting to the westward, but this current is probably confined to the vicinity of the coast.”

It is no doubt the current referred to in this last paragraph which was concerned in the drift of the *Bonthorpe*. It is most likely induced by the prevailing easterly winds of the summer months, which, as they blow fairly continuously, probably cause an important local swirl in the large expanse of water in the Great Australian Bight which, owing to the configuration of the

coast line does not receive the full influence of the main Southern Ocean current. As the air pressure systems move northward in the winter and the prevailing winds over the Bight become westerly it might be presumed that the direction of flow of the current would become reversed. A year's observation in this area, which will become possible when trawling becomes firmly established should provide data of value in this connection.

Confirmatory evidence of this drift to the south-west has been accumulated by Captain Claxton during the brief period of his trawling operations in the summer. He found that there was a constant tendency for the *Bonthorpe*, and buoys that were put out at the fishing ground, to drift to the southward, often at variance with the direction of the wind blowing at the same time.

In Australia the tendency has been to overlook the importance of these local coastal currents and to refer to the main oceanic currents exclusively in zoo-geographical theorising. As physiographical agents, however, it is recognised that the local shore currents play the principal part in moulding the relief of a coastline and in effecting other shoreline processes, and that the effect of oceanic currents is almost negligible. Due regard should no doubt be paid to such local currents also by zoo-geographers in any investigation on the distribution of marine organisms around the Australian littoral, particularly where it can be shown that the currents are of regular seasonal incidence.

2. PHYSIOGRAPHY.

From the soundings made by the *Bonthorpe* and from the data on the Admiralty charts, the dip of the continental slope, from the comparatively level shelf into the abyss, commences about the 70 fathoms contour line. Beyond this depth the contour lines are crowded together on the map and the *Bonthorpe's* soundings indicated marked declivity, as illustrated by the following depths recorded on February 23 whilst the vessel was hove-to and merely drifting with the current.

10·30 a.m.—Bottom not touched at 130 fathoms.

10·40 a.m.—Sounding of 89 fathoms.

11·50 a.m.—Sounding of 75 fathoms.

12·30 p.m.—Sounding of 100 fathoms.

In the early afternoon of the same day, whilst the vessel was slowly cruising around, sounding for a suitable depth to begin trawling, the following depths were recorded within 15 minutes :—

62 fathoms, 70 fathoms and 93 fathoms.

At each sounding a sample of the bottom deposit was collected from the sounding lead and preserved in neutral formalin. In all instances a firm, sandy bottom was indicated, of fine foraminiferal sand and evenly comminuted shell fragments.** The trawl brought up some fragments of limestone, but serious obstructions have never been encountered by the *Bonthorpe* during her operations in the area.

Geologically the adjacent land mass is a tableland of almost level-bedded limestones of Miocene age. The Bight is due to down-faulting, the scarp existing as the present line of limestone cliffs which border the Bight from Israelite Bay to the Head of the Bight, except between Twilight Cove and Eucla, where the scarp recedes inland as the Hampton Range. The Archipelago of the Recherche and the mainland to the north and west is of granite, a part of the Pre-Cambrian "shield" of Western Australia.

** The Foraminifera and Ostracoda of the soundings are reported on by F. Chapman and W. J. Parr, *Journ. Roy. Soc. W. Austr.*, vol. XXI, 1935, pp. 1-7.

III. THE FAUNA.

1. GENERAL.

The most comprehensive account of the fauna of the Western portion of the Bight is contained in the five volumes dealing with the biological results of the various cruises of the *Endeavour*, issued between 1911 and 1926. Other papers by independent workers are referred to in the sectional reports *infra* and the bibliography at the end of the paper.

The material from the present cruise, being from a single haul only, represents the concentrated gathering of the larger fauna of a strip of sea-bottom $3\frac{1}{2}$ miles in length and 100 feet wide, the trawl used being the German improved pattern of the Vigner-Dahl net.

The animals in greatest proportion were the fishes, the nannygai or red snapper (*Trachichthodes gerrardi* Günth.) predominating and presenting a conspicuous spectacle by reason of its glittering pink scales. The smaller invertebrates of course passed through the meshes of the net, but large masses of a yellow sponge provided a store of material. This yielded a small collection of amphipods and sphaeromid isopods, and polychaetes. A few polyzoans were abundant and there were some "fronds" of the elegant pink Gorgonid *Mopsea*. Sertularians were quite common. Specimens of a large cowrie, *Zoila* (= *Cypraea*, *auctt.*) *thersites* Gsk. were the only living gastropods taken, but several shells, principally volutes, were present, each one tenanted by a hermit crab. Small crabs, belonging to two species of *Pilumnus*, began crawling in numbers all over the deck as soon as the sorting of the fish commenced.

No specimens whatever of Algae were obtained.

The only specimens new to science were a foraminiferan already described by Messrs. F. Chapman and W. J. Parr and a fish belonging to the Genus *Paraperca*.

2. FISHES.

(a) List of Species.

There were 19 species included in the haul, and in addition specimens belonging to five other species collected by Captain Claxton from a cruise in December, 1929, in 75 fathoms, were also examined. Much of the material was studied on board, and specimens of as many species as could be conveniently preserved with the limited facilities available were taken back to Perth. All of the fishes collected but one were referable to known species. Two additional forms, however, are new to the fish fauna of Western Australia, namely, *Pristiophorus nudipinnis* and *Garichthys mirus*. The latter species is of special interest in that it was previously known only in waters west of Bass Strait. In the late A. R. McCulloch's "A Checklist of the Fishes Recorded from Australia" (1929-30), Western Australia as a locality record is not mentioned for the following species taken in the haul, though specimens of them had previously been taken in local waters:—

<i>Parascyllium ferrugineum</i> ,	<i>Caesioperca lepidoptera</i> ,
<i>Squalus fernandinus</i> ,	<i>Zanclistius elevatus</i> ,
<i>Centriscops humerosus</i> ,	<i>Helicolenus papillosus</i> ,
<i>Trachichthodes gerrardi</i> ,	<i>Anoplocapros gibbosus</i> ,
<i>Cyttus australis</i> .	

Sub-Class ELASMOBRANCHII.

Order SELACHII.

Family HEMISCYLLIIDAE.

Parascyllium variolatum (Dum.)—Cat Shark.

Two male specimens were preserved by Captain Claxton from his previous haul. The species is said to be commonly taken in the trawl, but no examples came under notice on the present occasion.

Parascyllium ferrugineum McCull.—Rusty Cat Shark.

Parascyllium ferrugineum McCulloch, Zool. Res. *Endeavour* I, 1911, p. 7.

One specimen was brought up in the haul.

Family SQUALIDAE.

Squalus fernandinus Molina—Spiny Dogfish.

Several of these dogfishes were brought up, they being the most numerous of the Elasmobranchs in the catch.

Family PRISTIOPHORIDAE.

Pristiophorus nudipinnis Günth.—Naked-finned Saw Shark.

Pristiophorus nudipinnis Günther, Cat. Fish Brit. Mus., VIII., 1870, p. 432.
McCulloch, Zool. Res. *Endeav.* I., 1911, p. 10.

Three adult specimens were taken in the trawl, the pallid bodies and the quivering saw-like snout and the tentacles making them arresting objects when the catch was emptied on deck. They were frequently taken by the *Bonthorpe* and Captain Claxton had preserved embryos on board. The *Simplon* collected examples in Long. 133°, but until the present occasion the species had never been actually taken in Western Australian waters. Owing to a printer's error the name of the *Pristiophorus* taken by the *Penguin* was omitted from Mr. Clauert's report (1921, p. 44), but I am informed by him that it was *P. cirratus*.

Family SQUATINIDAE.

Squatina tergocellata McCull.—Large-spotted Angel Shark.

Squatina tergocellata McCulloch, *Biol. Res. Endeavour*, II, 1914, p. 84.

One specimen was captured in the trawl and Captain Claxton had preserved an embryo taken from a female collected on a previous voyage. He stated that it was not uncommon in the catches, though hitherto in Southern Australia it has been known only from the single specimen on which McCulloch founded the species, collected by the *Endeavour* in this region of the Bight.

Sub-Class TELEOSTOMI.

Order TELEOSTEI.

Sub-Order ISOSPONDYLI.

Family GONORHYNCHIDAE.

Gonorhynchus greyi (Rich.)—Rat Fish.

Captain Claxton had on board a specimen taken in a previous haul, November, 1929, in 75 fathoms.

Sub-Order INIOMI.

Family AULOPIDAE.

Aulopus purpurissatus Rich.—Sergeant Baker.

One specimen was represented in the catch. Captain Claxton recalled its occurrence in the haul on only one previous occasion.

Sub-Order AULOSTOMI.

Family MACRORAMPHOSIDAE.

Centriseops humerosus (Rich.)—Bellows Fish.

Several specimens.

Sub-Order ANACANTHINI.

Family MACROURIDAE.

Garichthys mirus (McCull.)—Whip Tail.

Coelorhynchus mirus, McCulloch, *Zool. Res. Endeav.*, V., 1926, p. 178.

Garichthys mirus, Whitley, in McCulloch's "Fishes of New South Wales," 3rd. edn., 1934, Supp., p. 5.

A specimen of a whip-tail, which Captain Claxton preserved out of a haul made in 75 fathoms in December, 1929, was handed over to me. It agrees very well with McCulloch's description of a Sydney specimen of the above species which has hitherto remained unrecorded further west than the eastern edge of Bass Strait. The specimen represents an interesting new addition to the fauna of the State.

Sub-Order BERYCOIDEI.

Family BERYCIDAE.

Trachichthodes lineatus (Cuv. & Val.)—Swallow Tail.

Beryx lineatus Cuvier et Valenciennes, *Hist. Nat. Poiss.*, III., 1829, p. 226.

Trachichthodes lineatus, Waite & McCulloch, *Trans. Roy. Soc. S.A.*, XXXIX., 1915, p. 461.

A considerable quantity of these edible fishes was taken, but they were not as numerous as the following species, although some catches of the *Simplon* were made up almost exclusively of Swallow-tails. They are of a smaller size and readily recognisable by the deeply forked tail.

Trachichthodes gerrardi (Günth.)—Red Snapper (Nannygai).

Beryx gerrardi Günther, Ann. Mag. Nat. Hist., (5) XX., 1887, p. 238.

Austroberyx gerrardi, McCulloch, Zool. Res. Endeav., I., 1911, p. 41.

This species made up the bulk of the haul and it was stated that it was the most abundant of the fishes taken by the *Bonthorpe* during its previous operations. The fish was known on board as the nannygai, a name which is usually applied to the closely related *T. affinis* (Günther). Several specimens were examined on board and all were referable to *T. gerrardi*. In a report on Australian fisheries published in connection with the Great All Australian Exhibition of 1913, H. C. Dannevig gave a plate of *T. gerrardi* with nannygai as the vernacular name.

Sub-Order ZEOIDEI.

Family ZEIDAE.

Zeus faber Linn.—John Dory.

Specimens were taken in the trawl.

Cyttus australis (Rich.)—Silver Dory.

Several specimens were taken. Their colour differed from that given by Waite (1923, p. 100) in that the back and snout were of a bright pink instead of brown. The pink colour, however, rapidly vanishes in preserved specimens.

Sub-Order PERCOMORPHI.

Family HYPOPLECTRODIDAE.

Caesioperca lepidoptera (Bloch & Schn.)—Butterfly Perch.

One specimen was preserved out of the haul. The general colour was a rich purplish blue, with bright yellow along the base of the dorsal fin, sides of the head, base of the pectoral and base of the ventral fins.

Family CHAETODONTIDAE.

Chelmonops truncatus (Kner)—Coral Fish.

A common species.

Family HISTIOPTERIDAE.

Zanclistius elevatus (Rams. & Ogil.)—Short Boar Fish.

Several specimens were taken.

Sub-Order JUGULARES.

Family PARAPERCIDAE.

Parapercis (Neopercis) naevosa sp. nov.

PLATE II.

Description :—D. iv, 23 ; A. 19 ; V. i, 5 ; P. 19 ; C. 17 ; Ll. 58 ; Lt. 6, 16.

Length of head 4.0, height of body 5.1, and lengths of caudal, pectoral and ventral fins all 5.1 in the total length (exclusive of the caudal fin). Diameter of eye 2.6, inter-orbital space 11.2, length of snout 3.6, and height

of caudal peduncle 2.6 in the length of the head. The height of the body is slightly less than the width of the head and is equal to the length of the caudal fin.

Cleft of mouth slightly oblique, jaws equal with prominent lips. Maxilla reaches to the level of the middle of the eye. Eyes placed latero-dorsally.

Opercle with a flat spine above the root of the pectoral, its angle prominent with a few fine serrations. Pre-opercular border smooth.

The *teeth* consist of an outer row of prominent, spaced cardiform teeth in both jaws, behind which is a band of very small villiform teeth. The palatines and vomers are toothed.

In the *dorsal fin* the spines increase progressively in length from the front backwards, the last being double the length of the first, and 3.7 in the length of the head; the rays are 1.7 in the length of the head. The *anal fin* rises below the fifth dorsal ray and ends evenly with the dorsal fin, the rays are appreciably lower than the dorsals, and the posterior rays of both fins when folded back reach to the base of the caudal but not beyond. The *pectoral fins* are pointed, extending back to the beginning of the anal fin. The *ventral (pelvic) fin* is only very slightly shorter than the pectoral and reaches back as far as the vent. The *caudal fin* is rounded.

The top of the head and snout and a narrow zone around the eyes are scaleless. The naked area is covered with numerous rounded pores behind the eyes and sparingly so on the snout. A single row of pores extends along the pre-opercular border. The lateral line does not follow the contour of the back but curves down fairly boldly in the posterior part of the body.

Colour (after preservation), greyish white. Along the upper part of the body is a row of 15 regularly placed, brown spots on each side. The first three are very faint and are situated, respectively, behind the eye, on the opercle and above the base of the pectoral fin. The remaining 12 are well marked, and the last is set on the base of the caudal peduncle. The five anterior spots are below the lateral line, the sixth is crossed by it and the posterior nine are above. The six anterior spots are joined dorsally by faint brown bands which suggest that in the living condition the pattern may have been composed of transverse bands and not of separate spots. The above description was obtained three months after collection.

Total length, 115.5 mm.

Holotype collected by Captain L. W. Claxton from a haul made in 75 fathoms, December, 1929; preserved in the Western Australian Museum.

Affinities.—The presence of palatal teeth and the high posterior dorsal spines place the species in the sub-genus *Neopercis*, and the strong degree of curvature of the lateral line brings it into relation with *P. ramsayi* Steindachner, 1884, and *P. binivirgata* (Waite, 1904), both of which it resembles in general appearance, particularly the former in the contour of the anterior region, for the back between the eye and the base of the first dorsal spine is flat and not arched as in *P. binivirgata*. The large size of the eye is a prominent feature, and it is much larger than the eye of *P. ramsayi*, where it is only a quarter of the length of the head according to Ogilby (1885) ($\frac{3}{8}$ in *P. naevosa*). The ventral fin reaches only as far as the vent, which it fails to do in *P. ramsayi*, and over-reaches the vent to the second anal ray in *P. binivirgata*. The pectoral fin resembles that of *P. ramsayi* in shape and length, being much more pointed than in *P. binivirgata*, and shorter in that it does not extend as far back as the second anal ray. The opercle closely resembles *P. binivirgata*. It differs from the other Australian species of *Neopercis*,

P. allporti (Günther, 1876) in the curvature of the lateral line, in the relative sizes of the dorsal spines, the contour of the head region, in that the ventral fin does not reach to the anal, in colour pattern, and fin formulae.

The following key to the Australian species of the subgenus *Neopercis*, expanded from McCulloch, summarises some of these differences and resemblances :—

- A. Lateral line not following curve of back ; dorsal spines 4 or 5, increasing in size posteriorly.
- B. Dark blotches all above lateral line ; 5 dorsal spines ; ventral fin reaching beyond vent to the anal fin ; pectoral rounded and reaching to the second anal ray ; back between head and dorsal fin arched—*binivirgata*.
- BB. Some or all of the dark blotches extend to below lateral line ; 4 dorsal spines ; ventral and pectoral fins do not reach to second anal ray ; back between head and dorsal fin flattened.
- C. Blotches few (7) all below lateral line ; ventral fin not reaching vent ; eye small—*ramsayi*.
- CC. Blotches many (15), anterior series below, posterior series above lateral line ; ventral fin reaching vent ; eye large—*naevosa* sp. nov.
- AA. Lateral line following curve of the back ; back with cross bars ; 5 dorsal spines, sub-equal ; ventral fin reaching to anal—*allporti*.

Sub-Order CATAPHRACTI.

Family SCORPAENIDAE.

Helicolenus papillosus (Bloch & Schn.)—Red Gurnard-Perch.

A specimen was preserved by Captain Claxton from the December haul.

Family TRIGLIDAE.

Pterygotrigla polyommata (Rich.)—Flying Gurnard.

Many specimens of this handsome fish were gathered by the trawl, but though it was highly prized as a food fish on board, the full quantity caught was not preserved as there is comparatively small demand for the species on the Western Australian market.

Chelidonichthys kumu (Less. & Garn.)—Red Gurnard.

Some specimens of this Gurnard were also obtained. It is likewise accounted as a good food fish whose quality is not properly appreciated locally.

Family PLATYCEPHALIDAE.

Platycephalus conatus Waite & McCull.—Deep-water Flathead.

Platycephalus (*Neoplatycephalus*) *conatus* Waite & McCulloch, Trans. Roy. Soc. S.A., XXXIX, 1915, p. 466.

This species ranked second to the red snapper in abundance.

Sub-Order PLECTOGNATHI.

Family ALUTERIDAE.

Nelus ayraudi (Q. & G.)—Chinaman Leather Jacket.

Several leather jackets were taken and with other species made up one basket of miscellaneous food fishes. The crew of the trawler spoke of the peculiar young produced by this fish, which, however, was ascertained from descriptions to be a Cymothoid isopod. None of the parasites, however, were seen on the present occasion, though the fishermen kept a special lookout for them. One specimen collected by a student of the University from the deck of the *Bonthorpe* at Albany on another occasion has been examined by the writer and found to be *Ourozeuktes owenii* Milne-Edwards, a common parasite on local leather jackets.

Family OSTRACIONTIDAE.

Anoplocapros gibbosus Waite & McCull.—Humpty-Dumpty.

Anoplocapros gibbosus Waite & McCulloch, Trans. Roy. Soc. S.A., XXXIX, 1915, p. 480.

Several of these box fishes were trawled up. They were known as "foot-ballers" to the crew.

Capropygia unistriata Kaup.—Striped Box Fish.

Capropygia unistriata Kaup, Arch. f. Naturg., XXI, 1855, p. 220.
Waite & McCulloch, l.c., p. 478.

One specimen preserved out of the catch has the flat spines on the lateral ridges, not sharp-pointed as figured by Waite and McCulloch, but markedly truncated, the spines being flatly trapezoidal in shape.

(b) Trawling Operations.

The commercial potentialities of the fish fauna of the western portion of the Great Australian Bight were known principally from the results of three previous trawling expeditions. The thorough prospecting of the F.I.S. *Endeavour* laid the foundations of the work, and this was supplemented by the cruises of the South Australian Government Trawler *Simplon* in 1914 and the Western Australian Government trawler *Penguin* in 1920. The activities of the latter were cut short by its wreck near Esperance. The *Simplon* trawled over an area whose western limit was 2° 23' east of the locality fished over by the *Bonthorpe*. It is interesting to note that its results were not altogether favourable, thus contrasting sharply both with the experiences of the *Endeavour* and those of the *Bonthorpe*. However, the *Simplon* put down only ten hauls and operated under adverse weather conditions.

Captain Claxton has found the edge of the continental shelf, in particular about a depth of 75 fathoms, to be the most favourable zone for fishing, and during his operations, between November, 1929, and February, 1930, he trawled between 70 to 75 fathoms, the haul at 93 fathoms of the last cruise, on which this paper is based, being exceptional in its greater depth.

The main food fishes taken in the hauls are nannygai, leather jackets and deep-water flathead, and detailed records of the quantity of each of these taken on two of the earlier cruises, namely, January 12-18, and February 4-10, 1930, are filed with the Department of Fisheries and Game. They reveal some very interesting information, and are utilised here through the courtesy of the Chief Inspector (Mr. F. Aldrich).

Captain Claxton, when he started his operations in this area, soon found that the night hauls were much richer than those made during the day. The records he kept of the number of baskets of fish taken in each haul contain details of the duration of the haul, time, depth, etc., and the graph on (Plate III.) which has been constructed from his figures by the writer, clearly shows the regular alternation of poor and good catches each day and night. The graph shows the catch of nannygai and flathead between January 12 to 18. The figures, very low during the day, rise rapidly each evening after 7 o'clock, and reach a maximum by midnight, falling again to low values by 9 o'clock in the morning. The figures for leather-jackets show a similar tendency, but the catches of these fish were comparatively small in the cruises concerned.

As has been mentioned only one haul was made on the cruise on which the writer was present, engine trouble curtailing the operations. This haul was made at 93 fathoms, a greater depth than any hitherto, and was made between 3.30 and 5.30 p.m. The surprising result is that though it was a daylight haul, the quantity of fish taken was a record one, and believed to be the greatest ever taken in a single haul on these grounds. There were 32 baskets of nannygai (about 15 fish to each basket, of a total weight of about 45 lbs.) and 27 baskets of flathead (averaging 28 fish per basket).

The most obvious factor which has a bearing on the richness of this unprecedented daylight haul is the depth. The previous daylight hauls, notable for their barrenness, were usually made between 70 to 75 fathoms, and one was made at 50 fathoms when no fish at all were taken. The fish definitely seem to move up and down during the twenty-four hours, rising into shallow water in the night and moving back into deeper water in the day. As in other parts of the world, this is no doubt a phenomenon intimately connected with the food supply. Some essential link in the food chain is directly dependent on copepods, whose diurnal rise and fall impose a similar rhythm on all the associated predators. Professor W. J. Dakin (1931, p. 31) has suggested a similar cause for the diurnal movements of the tiger flathead in the trawling grounds in New South Wales. There is a difference, however, between the conditions there and in the Bight. In New South Wales the night catches are poor and those in daylight good, for the nightly rise of the fish takes them up from the sea bottom out of reach of the trawl. In the Bight the *Bonthorpe* trawling ground was at the very edge of the continental shelf, which, as has been shown earlier, is decidedly steep. The most feasible explanation on present evidence of the local conditions is that the fish move up and down the slope, and therefore they are within range of the trawl both night and day. Night fishing would take them at relatively shallow depths, while day fishing would have to be carried on further down the slope. At night the fish rise within the 70 fathoms line, and in the day-time retreat deeper. The one successful daylight haul captured them at the 93 fathoms level, and as this was in the late afternoon the fish were rising, therefore the centre of the concentration of the shoals at noon must be considerably deeper.

3. MOLLUSCA.

Very few molluscs were contained in the haul, being represented for the most part by empty shells of large gastropods inhabited by hermit-crabs (*Dardanus arrosor*). The only live specimens were two species of *Zoila* (= *Cypraea* Auctt.). In 1912 Sir Joseph Verco accompanied the *Endeavour* on a cruise to the western portion of the Bight and specialised in the collecting of shells, supplementing the meagre catch from the ship's trawl with a bucket dredge.

Of the nine species represented in the *Bonthorpe* collection, all but two, *Cuspidaria erma* and *Zoila friendii*, were recorded by Verco. A feature of the collection is the pallor of the shells. While this is partly due in some of the examples to their being "dead" shells, the *Cypraea* series and others strongly suggest that it is an effect of the darkness.

Class PELECYPODA.

Order SEPTIBRANCHIA.

Family CUSPIDARIIDAE.

Cuspidaria erma Cotton.

Cuspidaria erma Cotton, Rec. S.A. Museum, vol. IV, No. 3, 1931, p. 347.

A single right valve was recorded from the haul. The shell is thin and ovate in outline. Umbo slightly opisthogyrous. Antero-dorsal border concave. Anterior end ovate; the convex ventral border passing concavely into the rostrum which has an upward tilt. Resilifer directed obliquely forward. A sharp lamina-like tooth extends from the resilifer half-way along the postero-dorsal border. The antero-dorsal border has just the suggestion of a groove on the inner surface near the umbo. The exterior sculpture consists of numerous, more than 30, sharp concentric ridges, which are pronounced also on the interior surface. They pass obliquely on to the rostrum where, however, they become less defined and are evident only as a set of fine indefinite anastomosing ribbings. The main concentric ridges are marked by secondary lines, and the intervals between them by fine growth lines. Colour, dull white. Antero-posterior length, 38 mm.; umbo-ventral length, 23 mm.

This specimen was forwarded to the Adelaide Museum where Mr. B. C. Cotton identified it with a species he has described from off Eucla. The present specimen is considerably larger than his type which, moreover, has only 24 concentric ridges.

Class GASTROPODA.

Order PECTINIBRANCHIA.

Family CYPRAEIDAE.

Zoila friendii (Gray).

Zoila friendii has been taken by local collectors between Cottesloe and Cape Naturaliste; but is known from Esperance and, extra-limitally, from Java. The securing of a specimen so far to the east is of interest. It was not

taken in the haul under review, but Captain Claxton preserved a shell from a previous haul in 75 fathoms. It was a small specimen 51 mm. long, with the brown markings mainly developed in a restricted zone on the dorsal surface, most of the shell being a creamy white, a character, no doubt, due to its deeper water habitat. The three species, *Z. decipiens* from the North-West, *Z. friendii* from the South-West coast, and *Z. thersites* from South Australia and the Bight, are very much alike, and hitherto it was considered that their ranges were distinct.

***Zoila thersites* (Gsk.)**

Cypraea thersites Gaskoin, Proc. Zool. Soc., 1848, p. 90.

Verco, Trans. Roy. Soc. S.A., vol. xxxvi, 1912, p. 209

Zoila thersites contraria Iredale, Austr. Zool., 1935, vol. 8, p. 107.

One specimen was trawled alive but there was a collection of five more specimens on board, all obtained alive on previous cruises. The entire series was pallid in the extreme, the shells being almost devoid of any colouration. Four of the examples were solid, fairly old mature shells, three of them having the spire almost wholly enclosed. The two remaining ones were light young shells with a distinct orange-coloured spire. The smaller, 60 mm. long, was of a delicate blue-grey tint with two medial transverse darker bands of pale orange-buff. One of the more mature shells also possessed these pale buff bands on a whitish ground, with orange spots around the borders and the extremities of the shell. In the others the spots were of a brown colour and were dotted generally over the shell, forming an ill-defined zone in the region which the dark bands occupied in the young shells. These more massive shells were from 69 to 82 mm. in length. Plate IV. shows one of the shells contrasted with a normally pigmented specimen, richly marbled with deep brown and chestnut, from St. Vincent Gulf, South Australia. The pigmented shell was quite opaque to light, the deep-water ones being translucent. Until Sir Joseph Verco collected his specimens at depth in the western Bight the species was unknown beyond St. Vincent and Spencer Gulfs. Iredale recently described these forms as a new sub-species, *Z. t. contraria*, characterised by their "sub-adult appearance and whitish colouration."

Family **TONNIDAE.**

***Tonna variegata* (Lam.).**

The shell is pale and rather sparingly ornamented with chestnut spots. It contained a hermit crab.

Family **FUSIDAE.**

***Verconella oligostira* (Tate).**

The single specimen, tenanted by a hermit crab, agrees well with Verco's description of the examples he collected (1912, p. 221), being markedly angulated with comparatively sharply pointed coronating tubercles. The spiral cords are well indicated but the longitudinal striae are not so apparent as in other specimens examined by the writer from the South-West coast. The interior is a polished flesh colour.

Family **VOLUTIDAE**.**Ericusa fulgetrum** (Sowerby).

The example collected did not possess any axial zig-zag markings. Verco remarked that the shells he obtained from this area were all dead specimens and tenanted by hermit crabs, as was the case with the present specimen.

Livonia roadnightae (McCoy).

This single specimen, which was occupied by a hermit crab, is without colour. Two live shells, collected by the late H. C. Dannevig, in 100 fathoms, and referred to by Verco, are almost albino varieties.

Cymbiola nodiplicata (Cox).

Voluta nodiplicata Cox, Proc. Malac. Soc., ix, 1910, p. 146.

Scaphella dannevigi Verco, l.c., p. 224.

Cymbiola nodiplicata, Hedley, Journ. Roy. Soc. W.A., vol. i, 1916, p. 201.

Sir Joseph Verco collected nine examples 90 miles west of Eucla and described them as a new species, *Scaphella dannevigi*, which Hedley has relegated to the synonymy of Cox's species, described from Rottneest Is. The *Bonthorpe* specimen agrees with Verco's description and plate, and like his type it has lost the protoconch. It was tenanted by a hermit crab.

Cymbium flammeum (Bolten).

The specimen measures 19·2 cm. in length and has only three columellar plaits, agreeing both in size and the number of plaits with the third of Verco's *Endeavour* examples, his others being smaller shells with four plaits. A large hermit crab occupied the shell.

4. CRUSTACEA DECAPODA.

Seven species of Decapod Crustacea were contained in the *Bonthorpe* collection, one being an addition to the Bight fauna and others representing species which have not been taken other than by the *Endeavour*.

Order DECAPODA.

Sub-Order NATANTIA.

Tribe CARIDEA.

Family **RHYNCHOCINETIDAE**.**Rhynchocinetes rugulosus** Stimpson.

Rhynchocinetes rugulosus Stimpson, Proc. Acad. Sci. Philadelphia, vol. xii, 1860, p. 36.

Kemp, Rec. Ind. Mus., vol. xxvii, 1925, p. 263.

Gordon, Proc. Zool. Soc. Lond., 1936, pt. i, p. 75.

A single specimen was found, the first record for south-western Australian seas. It measured 34·5 mm. There were two teeth on the carapace

behind the rostral articulation, with four teeth on the upper border of the rostrum near the tip and ten on the lower border. There was a prominent supra-orbital spine and the cuticle was conspicuously striated. Later, in February, 1932, a second Western Australian specimen was collected in shallow water at Triggs Is., 10 miles north of Fremantle and sent to the W.A. Museum by the finder. It measured 61 mm. and had eleven teeth on the ventral border of the rostrum. Neither of the specimens was dissected.

Sub-Order REPTANTIA.

Section ANOMURA.

Family **PAGURIDAE.**

Dardanus arrosor Herbst.

Hermit crabs were abundant in the haul, all of the empty gastropod shells trawled up being tenanted by a specimen. Only the one species occurred, represented by six examples collected. The fact that no uninhabited shells were secured suggests that the gastropod fauna may be a limiting factor in the number of Pagurids.

Section BRACHYURA.

Family **INACHIDAE.**

Leptomithrax globifer Rathbun.

Leptomithrax globifer Rathbun, Biol. Res. *Endeavour*, vol. v, 1918, p. 25.

Captain Claxton preserved a specimen trawled in 75 fathoms in December, 1929. It was from approximately the same area that the type specimens described by Dr. Rathbun were taken by the *Endeavour*. The species has not otherwise been collected.

Family **PORTUNIDAE.**

Nectocarcinus tuberculosus (A. Milne-Edwards).

One ovigerous female; carapace 28 mm. long by 36 mm. broad from spine to spine.

Thalamita sima M. Edw.

One specimen of this widely distributed species was obtained. The diameter of the egg is .43 mm. The dimensions of the specimen are 35 mm. wide by 28 mm. long.

Family **XANTHIDAE.**

Pilumnus rufopunctatus Stimpson

Pilumnus rufopunctatus Stimpson, Proc. Acad. Sci. Phil., x, 1858, p. 36.

Rathbun, Biol. Res. *Endeavour*, vol. v, 1923, p. 115.

This and the following species were very abundant in the haul. The largest specimen measured 21 mm. in length and 23 mm. in width. The ova of this species are .55-.64 mm. in diameter.

Pilumnus acer Rathbun.

Pilumnus acer Rathbun, Biol. Res. *Endeavour*, vol. v, 1923, p. 124.

Several specimens of this species were taken, the dimensions of the carapace of the largest being 21 mm. long by 28 mm. wide (with spines). The specimens compare satisfactorily with Miss Rathbun's description. The ova are much larger than those of the preceding species and fewer in number, being 1.52–1.65 mm. in diameter.

5. ECHINODERMATA.

By E. W. BENNETT, M.Sc.

The Echinoderms in the collection include seven species. There are four specimens of an Ophiuroid, and one each of two species of Holothurians. They are not dealt with here, but have been forwarded intact to Dr. H. L. Clark, of Harvard, who is engaged in a study of Echinoderms recently collected in this State, and who, moreover, is already familiar with the deep-water Echinoderms secured by the *Endeavour* in the Great Australian Bight and elsewhere. There are nine Asteroids in the collection, representing four species; specimens have also been forwarded to Dr. Clark for confirmation.

The Asteroids include nothing new, unless the specimen of *Pseudophidiaster* merits separation. The species were otherwise all secured by the *Endeavour* but two were not collected before or since that expedition.

Class ASTEROIDEA.

Family GONIASTERIDAE.

Nectria ocellata Perrier.

Nectria ocellata Perrier, Archiv, de Zool. exp. et gén., V., 1876, p. 4.

Clark, Biol. Res. *Endeavour*, vol. IV, 1916, p. 34.

Rec. S.A. Mus., vol. III, 1928, p. 378.

Four specimens of average size. Clark compares the largest and smallest of his series of 22 specimens and states that the number of paxilliform ossicles does not increase, but that in the large specimen are so widely separated that the abactinal skeleton and papular areas are fully exposed. The present specimens form a well-graded series, which indicates scarcely any increase in the number of ossicles, but, nevertheless, a distal expansion of the ossicles, which more than keeps pace with the general growth. The paxillae are fully exposed in the smaller specimen, but hidden in the larger. The base of the pedicel does not grow proportionately and the papular areas are considerable in the large specimen. There is also disagreement with the figures quoted in the artificial key (Clark, 1928, p. 379) where $R:r$ is said to be 2.5 — 3. In the largest specimen, $R = 49$, $r = 3.5$; in the smallest, $R = 80$, $r = 21$, $R:r = 3.8$.

Family OREASTERIDAE.

Asterodiscus truncatus Coleman.

Asterodiscus truncatus Coleman, Mem. Aust. Mus., vol. IV, 1911, p. 699.

Clark, Biol. Res. *Endeavour*, vol. IV, 1916, p. 50.

Two specimens, agreeing well with Coleman's description and figures. $R = 83$, $r = 34$, $R:r = 2.44$ (regular); $R = 67 - 63$, $r = 24 - 25$, $R:r = 2.8 - 2.5$ (irregular).

Family **LINCKIDAE.****Pseudophidiaster rhyus** Clark.

Pseudophidiaster rhyus Clark, p. 54.

One specimen. $R = 114 - 122$, $r = 17$, $R : r = 6.7 - 7.2$. The granules become suddenly coarser between the ambulacral grooves and the first (actinal) row of papular areas, and still larger towards the jaws, but there are always at least 10 per sq. mm. Those of the dorsal surface almost uniformly small, about 60 per sq. mm., except around the periproct, which in the dried specimen is deeply sunken. Four upper series of papular areas very irregular on distal half of arm. Ambulacrals almost invariably with three equal spines. Sub-terminal ambulacral spines represented only by flat granules, but 27 conspicuous and projecting spines of varying length around the mouth, 4 — 8 in each angle. Pedicellariae apparently confined to ventral surface of disc, in a straight but broken series, 0 — 6 along each row of ambulacral plates, total about 30.

Colour: alive, dark purple; dried, pale dingy fawn.

There are slight but distinct differences from the specimens from 80—120 fathoms in the Bight, for which Clark founded the species and genus, and the verification of the specific identity of the species may be awaited with interest.

Family **ECHINASTERIDAE.****Plectaster decanus** (Muller & Troschel).

Echinaster decanus Muller & Troschel, Archiv. f. Naturg., IX, 1843, p. 114.

Plectaster decanus Clark, Biol. Res. *Endeavour*, vol. IV, 1916, p. 66; Rec. S.A. Mus., vol. III, 1928, p. 397.

Two specimens. $R = 105$, $r = 31$, $R : r = 3.4$; $R = 52 - 63$, $r = 17 - 19$, $R : r = 3.1 - 3.3$ (variable). In Clark's specimens $R : r = 4.3$, so that in the present series, which were preserved in neutral formalin and after about a week were dried out of corrosive formalin, the disc appears less shrunken.

Colour, alive, red and purple, in patches.

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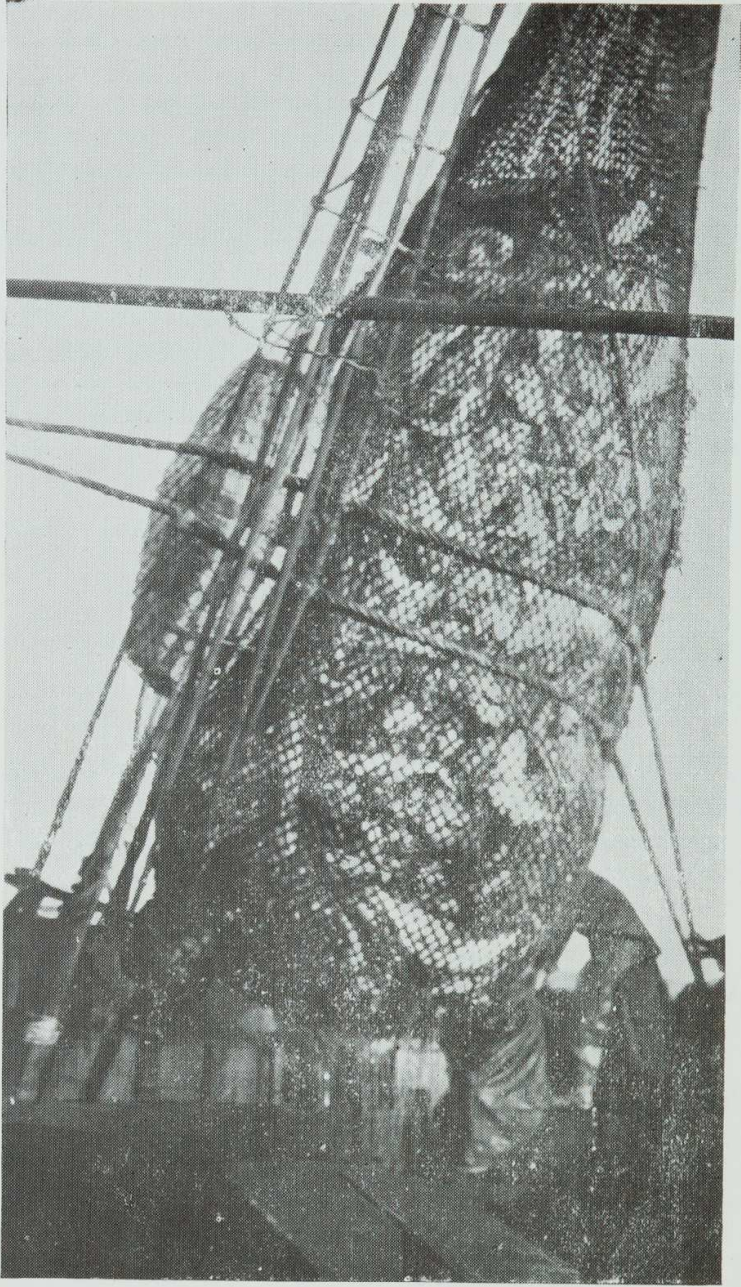


PLATE I.

The cod-end of the net containing the haul forming the subject of the present report. The stooping figure of the man on the right furnishes a standard for the estimation of size.

Photo: D. L. Serventy.

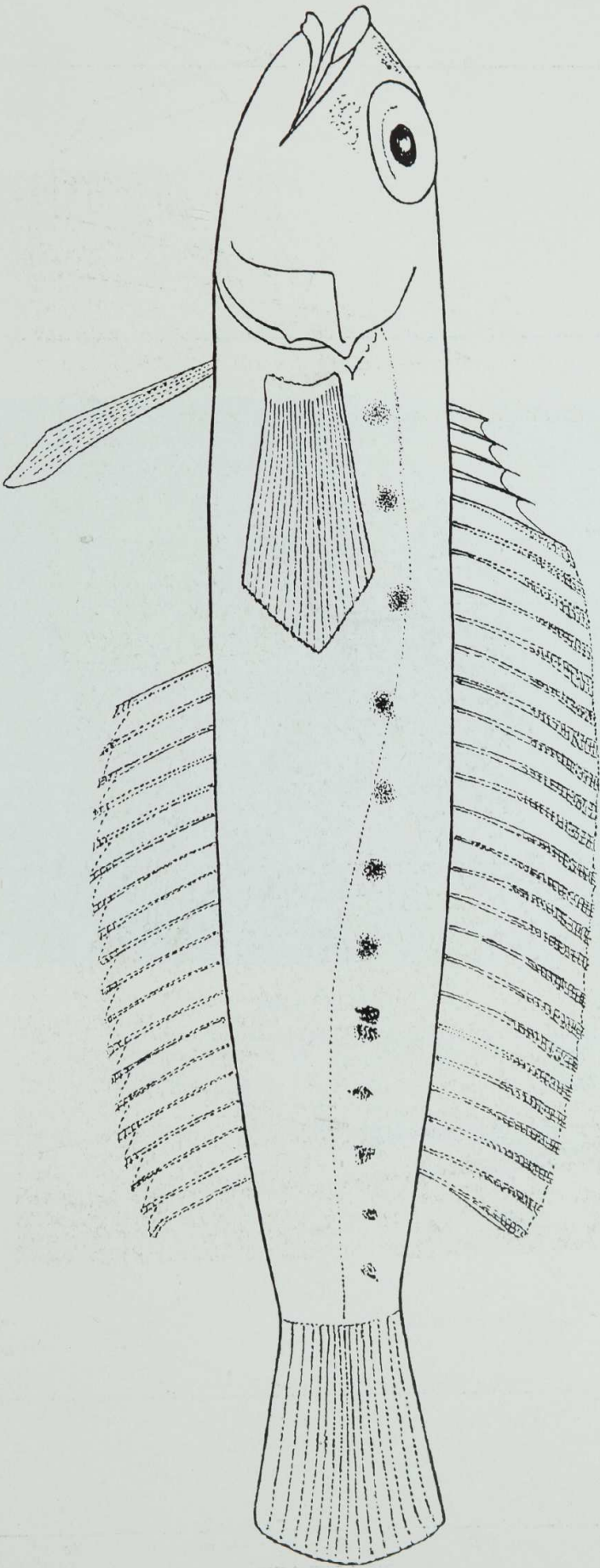


PLATE II.

Parapercis naevosa, sp. nov., $\times 1.65$

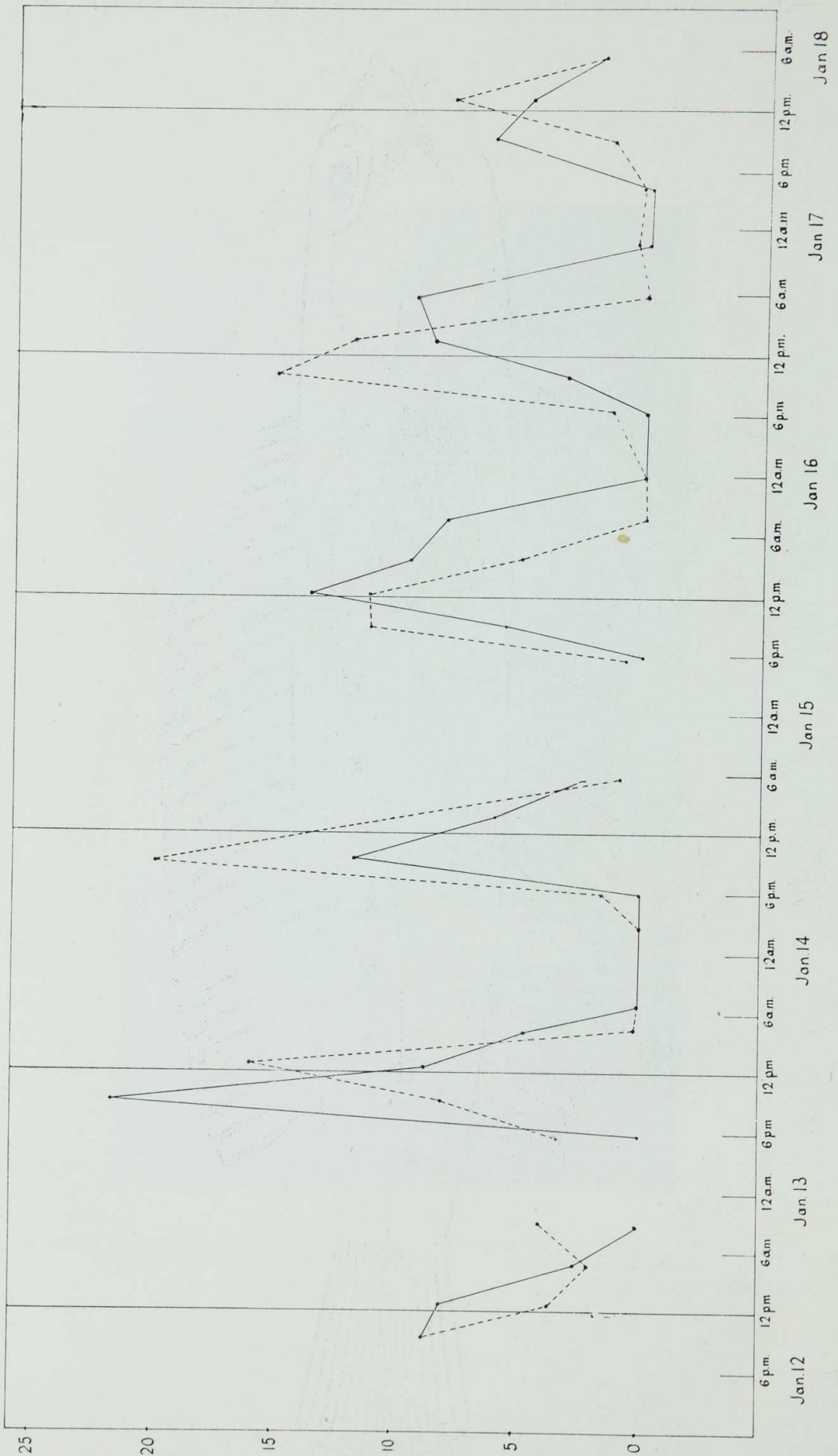


PLATE III.

Catches of Nannygai (full line) and Flathead (broken line) by the trawler *Bonthorpe*, January 12-18, 1930, between 70 and 75 fathoms. The vertical scale shows the number of baskets of fish obtained during two hours of trawling, the values being plotted along the horizontal scale at the mid-points of the trawling periods.

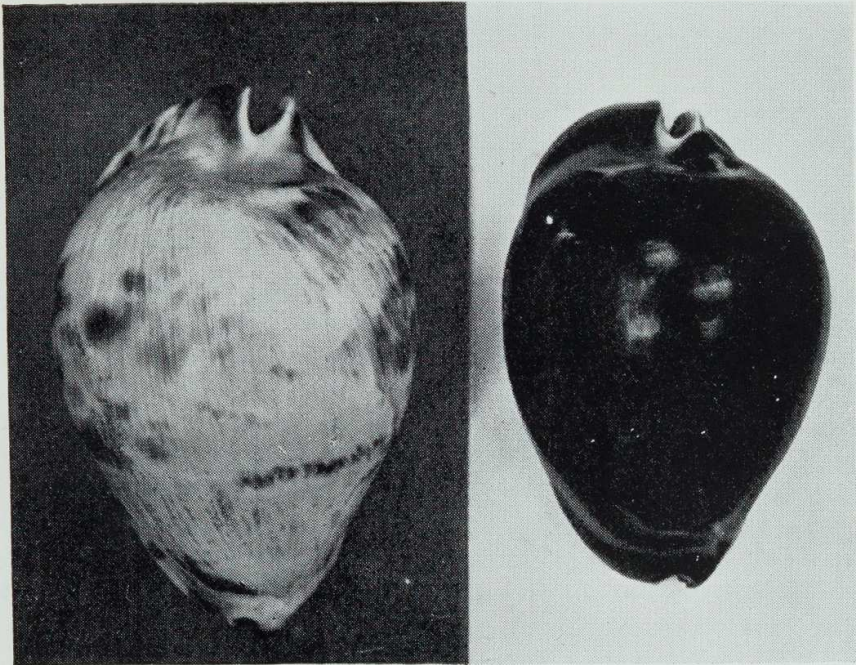


PLATE IV.

Pallid and pigmented specimens of *Zoila thersites*. The shell on the left is from the *Bonthorpe* collection, and that on the right from St. Vincent Gulf.

Photo: H. J. Smith.